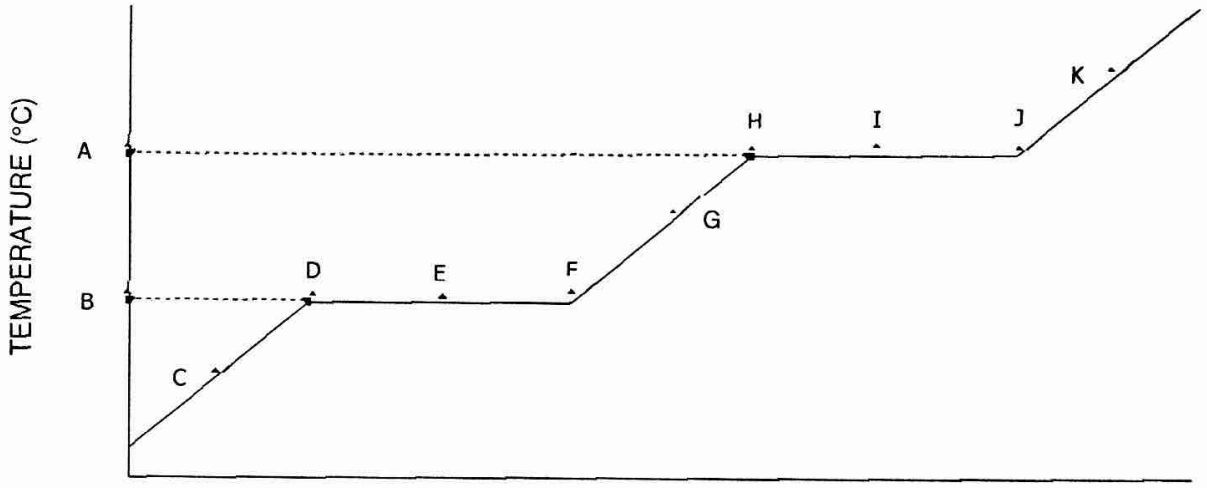
PHYSICS 11
HEATING CURVE WORKSHEET

Name KEY
(last) (first)

Due date: _____

A. Answer the questions below with respect to the following warming curve:



1. Circle the letter that corresponds to the freezing point. 1. A (B) C D E F G H I J K
2. Circle the letter that corresponds to the boiling point. 2. (A) B C D E F G H I J K
3. Circle the letters that correspond to points where the substance is present only in the liquid state. 3. A B C D E F (G) H I J K
4. Circle letter that corresponds to the point where the substance is present in both liquid and gaseous states. 4. A B C D E F G H (I) J K
5. Circle the letter that corresponds to the point where the substance is present in both solid and liquid states. 5. A B C D (E) F G H I J K
6. Circle the letters that correspond to the points where the substance is present only in the solid state. 6. A B (C) D E F G H I J K
7. If this was the warming curve for water, what kind of bonds (attractive forces) are being broken between point H and J ? 7. intermolecular

B. Solve the following problems, giving **complete set-ups, including all units,** and using correct significant figures. If work is not shown, *NO CREDIT* will be given for the correct answer.

PHYSICAL CONSTANTS FOR WATER		
FREEZING POINT = 0.00 °C		**BOILING POINT** = 100.00°C
SPECIFIC HEATS:	*SOLID* WATER = 2.10 J/g °C	*LIQUID* WATER = 4.18 J/g °C	*GASEOUS* WATER = 2.0 J/g °C
HEAT OF FUSION = 335 J/g		**HEAT OF VAPORIZATION** = 2.26 kJ/g

1. How much energy, in kilojoules, is needed to change the temperature of 123 kilograms of liquid water from 20°C to 35°C? 1. 7712 kJ

$$Q = mc\Delta T$$
$$= (123\,kg)\left(4.18\,\frac{J}{g\,°C}\right)(35°-20°C)\left(\times 1000\,\frac{g}{kg}\right)$$
$$Q = 7712.1\,kJ$$

PHYSICAL CONSTANTS FOR WATER			
FREEZING POINT = 0.00 °C			**BOLING POINT** = 100.00°C
SPECIFIC HEATS:	*SOLID* WATER = 2.10 J/g °C	*LIQUID* WATER = 4.18 J/g °C	*GASEOUS* WATER = 2.0 J/g °C
HEAT OF FUSION = 335 J/g		**HEAT OF VAPORIZATION** = 2.26 kJ/g	

2. How much energy, in joules, is needed to change 26.5 g of solid water at 0.0°C to liquid water at 48.3°C? 2. 14228 J

$S \to \ell$ $Q = mH_f$

$= (26.5g)(335 J/g)$

$= 8877.5\ J$

heat $Q = mc\Delta T$

$Q = (26.5g)(4.18 \frac{J}{g°C})$

$Q = 5350.91\ J \quad (48.3-0)$

TOTAL = 8877.5 + 5350.191

3. 5.00 grams of solid water at 0.00° are heated to 78.3°C. How much energy, in joules, must be added to cause this change? 3. 3311 J

$S \to \ell$ $Q = mH_f$

$= (5g)(335 J/g)$

$Q = 1675\ J$

heat ΔT $Q = mc\Delta T$

$Q = (5g)(4.18 \frac{J}{g°C})(78.3-0)$

$Q = 1636.47\ J$

TOTAL = 1675 + 1636.47

4. How many joules of energy must be added to 75.0 grams of solid water at -17°C to melt and raise its temperature to 99°C? 4. 58839 J

ΔT $-17°C \to 0°C$

$Q = mC\Delta T$

$= (75g)(2.10 \frac{J}{g°C})(0 - -17)$

$Q = 2677.5\ J$

$S \to \ell$

$Q = mH_f$

$= (75)(335 \frac{J}{g})$

$Q = 25125\ J$

ΔT $0°C \to 99°C$

$Q = mc\Delta T$

$= (75g)(4.18 \frac{J}{g°C})(99-0)$

$Q = 31036.5$

5. How much energy, in joules, are released when 9.45 g of gaseous water at 100.00°C is condensed and cooled to 18.6°C? 5. 24572 J

$g \to \ell$

$Q = mH_v$

$= (9.45g)(2.26 \frac{kJ}{g})$

$= -21357\ J$

ΔT $100 \to 18.6°C$

$Q = mc\Delta T$

$= (9.45g)(4.18 \frac{J}{g°C})(18.6-100)$

$Q = -3215.38$

6. To what temperature will liquid water be raised when 2298 joules of energy are added to 4.50 g of solid water at 0.00°C? 6. 42°C

$Q = mc\Delta T$

$2298 = (4.50g)(2.10 \frac{J}{g°C})(T_f - 0)$

$T_f = 243°C$ X → must account for phase change

ΔT

$790.5 = (4.5g)(4.18 \frac{J}{°C})\Delta T$

$790.5 = 18.81\Delta T$

$\Delta T = 42.03$

$S \to \ell$

$Q = mH_f = (4.50)(335)$

$= 1507.5\ J$ to melt → $2298 - 1507.5 = 790.5\ J$ left for raising temperature.